

# Mineral of the Month Club January 2017

## CUPRITE ON COPPER

This month our featured mineral is cuprite on native copper from the Carissa Pit in the Battle Mountain Mining District of north-central Nevada. Our write-up explains the mineralogy and occurrence of cuprite; our special section discusses the properties, history, and uses of copper.

### OVERVIEW

#### PHYSICAL PROPERTIES:

Chemistry: Copper (Cuprous) Oxide  $\text{Cu}_2\text{O}$

Class: Oxides

Subclass: Simple Oxides

Group: Cuprite

Crystal System: Isometric (Cubic)

Crystal Habits: Usually octahedral, less commonly cubic and dodecahedral or as combinations of these three habits; crystal modifications and penetration twins are common; also occurs in fibrous, compact, scaly, granular, and earthy forms.

Color: Ruby-red, carmine, coppery-red, reddish-gray, reddish-brown, brown, reddish-black, and near-black.

Luster: Adamantine and submetallic to earthy

Transparency: Crystals are transparent to translucent; massive forms are usually opaque.

Streak: Submetallic brownish-red

Refractive Index: 2.849

Cleavage: Fair to poor in four directions to form octahedrons

Fracture and Tenacity: Conchoidal to uneven; brittle.

Hardness: 3.5-4.0

Specific Gravity: 6.14

Luminescence: None

Distinctive Features and Tests: Best field marks for cuprite are octahedral crystal form; softness; submetallic, brownish-red streak; occurrence in the oxidized portions of copper deposits in association with malachite [basic copper carbonate,  $\text{Cu}_2(\text{CO}_3)(\text{OH})_2$ ], azurite [basic copper carbonate,  $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$ ], chrysocolla [basic hydrous copper aluminum acid silicate,  $(\text{Cu,Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot n\text{H}_2\text{O}$ ], chalcocite [copper sulfide,  $\text{Cu}_2\text{S}$ ], and native copper [element, Cu]. Can be confused with spinel [magnesium aluminum oxide,  $\text{MgAl}_2\text{O}_4$ ], which is much harder and has a white streak, and sphalerite [zinc sulfide, ZnS], which differs in crystal structure and occurs only in sulfide environments.

Dana Mineral-Classification Number: 4.1.1.1

**NAME:** Cuprite is named after *cuprum*, the Latin word for “copper,” alluding to its chemical composition. Cuprite has been known as “red copper,” “red copper oxide,” “ruby copper,” “ruby copper ore,” “copper blossom,” “Lebererkupfer,” “ruberite,” “Zieglererz,” “Kupferglas,” “Hepatinerz,” “hydrocuprite,” and “octahedral copper.” A fibrous form of cuprite is called “chalcotrichite.” In European mineralogical literature, cuprite appears as *Kuprit and cuprita*.

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**COMPOSITION & STRUCTURE:** Cuprite's molecular weight is made up of 88.82 percent copper (Cu) and 11.18 percent oxygen (O). Of all the copper-bearing minerals, cuprite contains the highest percentage of copper by weight. Cuprite is a member of the simple-oxide subgroup of the oxide-group minerals. The 111 members of the simple-oxide subgroup all consist of a single metal combined with oxygen. Cuprite crystallizes in the isometric (cubic) system, which has three mutually perpendicular axes of equal lengths. Cuprite has an unusually complex crystal structure in which its oxygen ions form a body-centered cube, while its copper ions form a face-centered cube. The body-centered oxygen frame has sufficient unoccupied space to accommodate the face-centered copper frame, thus producing two sub-lattices within a main lattice. In this main lattice, each copper ion is centered between two large oxygen ions, while each oxygen ion is in tetrahedral coordination with four copper ions. This arrangement modifies the basic cubic structure, enabling cuprite to occur in cubic, octahedral, and dodecahedral habits. Cuprite forms in the oxidized, upper portions of copper deposits in association with azurite, malachite, chrysocolla, chalcocite, chalcantite [hydrous copper sulfate,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ], and native copper. Cuprite alters readily and is sometimes reduced to native copper to form copper-after-cuprite pseudomorphs. In contact with free atmospheric oxygen and acidic groundwater, cuprite can alter into malachite to form malachite-after-cuprite pseudomorphs. As an idiochromatic (self-colored) mineral, cuprite's generally reddish colors are caused by the manner in which its crystal lattice reflects light. Many copper-bearing minerals, such as azurite, malachite, and chalcantite, are blue or green in color. These minerals all contain cupric copper in the +2 valence state ( $\text{Cu}^{2+}$ ), which is a powerful chromophore (color-causing agent) for the colors blue and green. But in cuprite, copper is present in its cuprous form as  $\text{Cu}^{1+}$ , which is not a blue-green chromophore.

**COLLECTING LOCALITIES:** Cuprite is collected in the United States (Nevada, Arizona, Wisconsin, New Mexico, Pennsylvania, Michigan, Missouri, and Utah), Mexico, Chile, Bolivia, Namibia, Democratic Republic of the Congo, South Africa, Zambia, China, Australia, Italy, France, Russia, Spain, England, Kazakhstan, and Germany.

**HISTORY, LORE & GEMSTONE/TECHNOLOGICAL USES:** As early as 1546, cuprite was known to German miners who called it *Lebererkupfer*, or "liver of copper." Because it was confused with other mineral species in the German mines, it later acquired such names as "ruberite," "Zieglererz," "Kupferglas," and "Hepatinerz." In 1845, Austrian mineralogist Wilhelm Karl von Haidinger (1795-1871) determined that all these names referred to minerals with identical chemical compositions and crystal structures. They were all thus the same species, which he formally named "cuprite" after *cuprum*, the Latin word for "copper." Because its complex and unusual crystal structure interested researchers, cuprite was one of the first minerals analyzed by the then-newly-developed X-ray diffraction method in 1918. Cuprite has many excellent gemological qualities, including beautiful reddish colors and an unusual brilliance that is due to a very high index of refraction that exceeds that of diamond [carbon, C]. Unfortunately, cuprite is far too soft (Mohs 3.5-4.0) to stand up to regular jewelry wear. Also, flawless cuprite crystals large enough to facet are rare. Cuprite was not well-known until 1974, when transparent, gem-quality crystals were found in a large pocket at a copper mine in Onganja, South-West Africa (now Namibia). This pocket yielded the largest cuprite crystals ever found, some measuring three inches in length and weighing 4.5 pounds. Although most cuprite collectors'

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gems weigh less than one carat, they are in high demand for their color and brilliance. Cuprite crystals are also popular among mineral collectors for their rarity, distinctive color, and occurrence as both individual specimens and as composites in association with malachite, azurite, chrysocolla, and native copper. Both cuprite and native copper were formerly important ores of copper. Modern metaphysical practitioners believe that cuprite helps to recall past-life experiences, attract appropriate teachers and mentors, develop humanitarian instincts, and release ill-feeling and resentment stemming from controls and restrictions imposed by authoritative and abusive figures in one's past life. Cuprite is also thought to help alleviate ailments of the heart, circulation system, and kidneys.

**ABOUT OUR SPECIMENS:** Our cuprite specimens were collected at the Carissa Pit in the Copper Basin area of the Battle Mountain Mining District. This district is near the community of Battle Mountain in Lander County, in the arid, basin-and-range country of north-central Nevada. Although unincorporated, Battle Mountain, population 3,600, is Lander County's largest community and its county seat. Covering 5,519 square miles, Lander County is larger than the state of Connecticut, yet it has only 6,000 residents. Battle Mountain's economy is based on gold and base-metal mining, ranching, and providing services for travelers on Interstate 80. Copper mining began at Battle Mountain in 1866. Today, the district's major, active mines are the Tomboy, Midas, Fortitude, and Phoenix open pits, and the Copper Canyon underground mine. The origin of the Battle Mountain Mining District ore deposits can be traced to the late Paleozoic Era when sediments laid down by ancient seas some 300 million to 240 million years ago lithified into massive formations of sandstone, siltstone, limestone, and shale. About 40 million years ago, graniorite magma and associated mineral-rich, hydrothermal solutions intruded these formations to emplace gold and sulfide minerals. After erosion had reduced the surface, these sulfides were subjected to chemical weathering, oxidation, and the action of acidic groundwater that created shallow, enriched bodies of copper, gold, silver, lead, and zinc ores. The considerable amount of native copper in these deposits formed as fracture and fissure fillings when copper-bearing groundwater solutions reacted with iron. The more chemically active iron displaced and reduced the copper, precipitating it in elemental form. In 1936, miners developed the Carissa underground mine after a small body of rich gold ore was discovered in an open cut. By the time the Carissa closed in 1954, it had produced 9,104 tons of ore that yielded 4,543 troy ounces of gold, 19,574 troy ounces of silver, and 270 tons of copper. The Carissa Pit was then developed in the 1970s and mined sporadically over the following decades. Exploration activities continue at the Carissa Pit, where commercial specimen collectors gathered our specimens of cuprite on copper in 2012.

### COMPREHENSIVE WRITE-UP

#### *COMPOSITION & STRUCTURE*

Cuprite's chemical formula  $\text{Cu}_2\text{O}$  identifies its elemental components as copper (Cu) and oxygen (O). Its molecular weight is made up of 88.82 percent copper and 11.18 percent oxygen. Of all the copper-bearing minerals, cuprite has the highest percentage of copper by weight. A mineral's molecular weight is the sum of the atomic weights of its constituent elements. The atomic weight of copper is 63.55; the atomic weight of oxygen is 16.00. Cuprite's molecular

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weight is therefore 143.1, which is the sum of the atomic weight of the two copper atoms (127.1) and one oxygen atom (16.0). In cuprite, the percentage of copper by weight is determined by dividing the atomic weight of the two copper atoms by cuprite's total molecular weight ( $127.1 \div 143.1 = 88.82$  percent). The weight percentage of any element in any mineral can be quickly calculated by this method. The atomic weights of all elements are stated on the periodic table of elements.

Cuprite is a member of the simple-oxide subgroup of the oxide-group minerals. The 111 members of the simple-oxide subgroup consist of a single metal combined with oxygen. Like all molecules, those of cuprite are made up of cations (positively charged ions) and anions (negatively charged ions). The balance of the collective +2 charge of its two copper (cuprous) cations  $2\text{Cu}^{1+}$  and the -2 charge of its single oxygen anion  $\text{O}^{2-}$  provides the cuprite molecule with electrical stability. Cuprite crystallizes in the isometric (cubic) system, which has three mutually perpendicular axes of equal lengths. Cuprite has an unusual crystal structure in which its oxygen ions form a body-centered cube, while its copper ions form a face-centered cube. The body-centered oxygen frame has sufficient unoccupied space to accommodate the face-centered copper frame. This produces two sub-lattices within a main lattice. In this main lattice, each copper ion is centered between two large oxygen ions, while each oxygen ion has a tetrahedral coordination with four copper ions. This arrangement modifies cuprite's basic cubic structure, enabling it to occur in cubic, octahedral, and dodecahedral habits.

Although the atomic bonding in cuprite is primarily covalent with shared electrons, some metallic bonding also exists. Because the copper ions are largely, but not completely, shielded by oxygen ions, cuprite exhibits a submetallic luster. The considerable inter-ionic distances within the lattice weaken the covalent bonding to explain cuprite's modest hardness of Mohs 3.5-4.0. Cuprite has a very substantial density (specific gravity 6.14) because the moderately heavy metal copper (atomic weight 63.55) accounts for 88.82 percent of its molecular weight. Cuprite is one of the densest of all transparent-to-translucent minerals.

Cuprite occurs in the oxidized, upper portions of copper deposits in association with azurite [basic copper carbonate,  $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$ ], malachite [basic copper carbonate,  $\text{Cu}_2(\text{CO}_3)(\text{OH})_2$ ], chrysocolla [basic hydrous copper aluminum acid silicate,  $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot n\text{H}_2\text{O}$ ], chalcocite [copper sulfide,  $\text{Cu}_2\text{S}$ ], chalcantite [hydrous copper sulfate,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ], and native copper [element, Cu]. Cuprite alters readily and is sometimes reduced to native copper to create copper-after-cuprite pseudomorphs. In contact with free atmospheric oxygen and acidic groundwater, cuprite can alter to malachite to form malachite-after-cuprite pseudomorphs.

As an idiochromatic (self-colored) mineral, cuprite's generally reddish colors are caused by the manner in which its crystal structure reflects light. Many copper-bearing minerals, such as azurite, malachite, and chalcantite, are blue or green in color. These minerals all contain cupric copper in the +2 valence state ( $\text{Cu}^{2+}$ ), which is a powerful chromophore (color-causing agent) for the colors blue and green. But in cuprite, copper is present in its cuprous form as  $\text{Cu}^{1+}$ , which is not a blue-green chromophore. Another example of a cuprous-copper mineral is chalcocite [copper sulfide,  $\text{Cu}_2\text{S}$ ], which has a dark-gray color. Cuprite's diagnostic ruby-red, carmine, coppery-red, reddish-gray, reddish-brown, brown, reddish-black, and near-black colors are caused by the light-reflecting characteristics of its crystal lattice.

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Cuprite's ability to refract light is among the highest of all minerals. Refraction or bending of light is expressed by index of refraction, which is the ratio between the speed of light in air and the speed of light in a crystal. The index of refraction of most mineral crystals and gemstones falls between 1.4 and 1.9. Higher numerical values indicate greater degrees of refraction and correspond directly to brilliance in gems. Diamond [carbon, C] is known for its brilliance and has an unusually high index of refraction of 2.417-2.419—still much less than that of cuprite (2.849). But unlike diamond, cuprite does not disperse white light into its spectral colors, an effect that gemologists refer to as “fire.”

Cuprite's Dana mineral-classification number of 4.1.1.1 first identifies it as a simple oxide (4). The subclassification (1) next defines it by the general formula  $A^{1+}O_2$ , in which “ $A^{1+}$ ” is monovalent or cuprous copper. Cuprite is then assigned to the cuprite group (1) as the first (1) and only member.

### *COLLECTING LOCALITIES*

Our cuprite specimens were collected at the Carissa Pit in the Copper Basin area of the Battle Mountain Mining District near Battle Mountain, Lander County, Nevada. Cuprite also occurs at the nearby Copper Basin, Contention, Copper King, and Copper Queen mines. In Arizona, cuprite is found at the Bisbee mines in the Warren district, Mule Mountains, Cochise County; the Ray Mine at Kearney, Ray district, Pinal County; the Morenci Mine at Morenci, Greenlee County; the New Cornelia Pit at Ajo, Pima County; and the Christmas Mine in the Banner district, Gila County. Localities in other states include the Flambeau Mine, Rusk County, Wisconsin; the Cuprite Mine near Magdalena in Socorro County and the Chino Pit at Santa Rita in Grant County, both in New Mexico; Cornwall, Lebanon County, Pennsylvania; the copper mines in Rockland, Mass City, and Greenland Township in Ontonagon County, Keweenaw Peninsula, Michigan; the Cornwall copper mines at Weingarten in St. Genevieve County, Missouri; and the Bingham Canyon Mine in Tooele County, Utah.

In Mexico, cuprite specimens are collected at the Ojuela Mine at Mapimí, Mapimí district, Durango; the Santa Rita Mine in the Boleo district, Mulagé, Baja California Sur; and the Milpillas Mine at Cuitaca, Sonora. Chilean specimens come from the Dulciano de Lamos Mine, Copiapó Province, Atacama Region; and the Chuquicamata Mine in the Chuquicamata District, Calama, El Loa Province, Antofagasta Region. Another notable South American locality is the Siglo Veinte Mine, Llallagua, Rafael Bustillo Province, Potosí Department, Bolivia.

In Africa, cuprite occurs in Namibia at the Onganja Mine, Seeis, Windhoek District, Khomas Region; and the Tsumeb Mine at Tsumeb, Otjikoto Region. Other African sources are the Mashanta West Mine in the Kolwezi District, Katanga Copper Crescent, Katanga, Democratic Republic of the Congo; the Opiek mines in the Namakwa District in Northern Cape Province and the Stavoran Mine in Sekhukhune District in Limpopo Province, both in South Africa; and the Kabwe Mine at Kabwe, Kabwe District, Central Province, Zambia.

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In China, cuprite is collected at the Chengmenshan Mine, Juijang County, Juijang Prefecture, Jiangxi Province; and the Fengjiashan Mine in Daye County, Huangshi Prefecture, Hubei Province. Australian specimens come from the Red Dome Mine at Mungana, Mareeba Shire, Queensland; the Cobar mines in Robinson County, New South Wales; and the Burra copper mines at Burra, Mt. Lofty Ranges, South Australia. Italian specimens are found at the Graveglia Valley mines at Ne, Genova Province, Liguria; and at Madonna de Fucinaia near Campiglia Marittima, Campigliese, Livorno Province, Tuscany. French localities include the Chessy copper mines at Chessy-les-Mines, Rhône, Rhône-Alpes; and the Le Moulinal Mine at Paulinet, Tarn, Midi-Pyrénées. Other sources are the Rubtsovskoe copper-zinc-lead mine at Poteryaevka, Altai Republic, Western-Siberian Region, Russia; the Rió Tinto Mines at Huelva, Andalusia, Spain; the New Cliffe Hill Quarry at Stanton under Bardonia, Leicestershire, England; the Dzehazkazgan and Itauz mines at Dzehazkazgan, Karagandy Province, Kazakhstan; and the Virneberg Mine at Rheinbreitbach, Westerwald, Rhineland-Palatinate, Germany.

### *JEWELRY & DECORATIVE USES*

Cuprite crystals have an intense red color and a very high index of refraction of 2.849 (see “Composition & Structure”) that imparts great brilliance to faceted gems. Also, a slight, but distinctive, submetallic luster on faceted cuprite gems adds to their overall appeal. Unfortunately, cuprite is far too soft (Mohs 3.5-4.0) to stand up to regular jewelry wear. And flawless cuprite crystals large enough to facet are rare. Joel Arem, former curator of the gem-and-mineral collection at the National Museum of Natural History (Smithsonian Institution) describes faceted cuprite of any size as “one of the most collectible and spectacular gems in existence.”

Cuprite was not well-known until 1974, when transparent, gem-quality crystals were found in a large pocket at a copper mine in Onganja, South-West Africa (now Namibia). This pocket yielded the largest cuprite crystals ever found, some measuring three inches in length and weighing 4.5 pounds. All were transparent and had a color described as “carmine”—a deep ruby-red with slight purple overtones. Some of these crystals were cut into flawless gems weighing more than 100 carats and are now major museum attractions. Virtually all the flawless cuprite gems in existence that weigh more than one carat were cut from crystals recovered in the 1974 Namibia find. Although no cuprite gemstones of this size and quality have since been found, cuprite collectors’ gems remain in high demand for their color and brilliance.

Most cuprite gems now on the market have inclusions that detract from their brilliance. Included gems of four carats typically cost about \$500 each. Flawless gems of this size cut from crystals recovered in Namibia in 1974 sell for about \$8,000.

Cuprite crystals are popular among mineral collectors for their rarity and distinctive color. Most cuprite specimens are composites in association with such minerals as malachite, azurite, chrysocolla, and native copper. A particularly unusual form of cuprite is “Sonora sunrise,” a composite of reddish-brown, massive cuprite and blue-green chrysocolla that is cut into cabochons and figurines.

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## *HISTORY & LORE*

As early as 1546, cuprite was known to German miners who called it *Lebererkupfer*, or “liver of copper.” But because it was often confused with other mineral species from the German mines, it later acquired such names as “ruberite,” “Zieglererz,” “Kupferglas,” and “Hepatinerz.” In 1845, Austrian mineralogist Wilhelm Karl von Haidinger (1795-1871) determined that all these forms of copper oxide had the same chemical composition and crystal structure, and that they therefore all represented the same mineral species, which he formally named “cuprite” after *cuprum*, the Latin word for “copper.” Because its complex crystal-lattice structure was of interest to researchers, cuprite was one of the first minerals to be analyzed by the then-newly-developed X-ray diffraction method in 1918.

Modern metaphysical practitioners believe that cuprite helps to recall past-life experiences, attract appropriate teachers and mentors, develop humanitarian instincts, and release ill-feeling and resentment about controls and restrictions imposed by authoritative and abusive figures in one’s past life. Cuprite is also thought to help to alleviate ailments of the heart, circulatory system, and kidneys.

Cuprite appeared on the 8-zaire postage stamp of Zaire (now the Democratic Republic of the Congo) in 1983.

## *COPPER: THE “RED METAL”*

This month’s featured mineral, cuprite on copper, gives us the opportunity to take an in-depth look at copper—the “red metal”. Copper, chemical symbol Cu, is a reddish metal with a bright, metallic luster. At Mohs 2.5-3.0, it is slightly harder than gold and silver. Copper ranks 25<sup>th</sup> among the elements in crustal abundance, making it considerably more abundant than silver (66<sup>th</sup>), but far less common than iron (4<sup>th</sup>). With a specific gravity of 8.9, copper is more dense than iron (s.g. 7.9), but less dense than silver (s.g. 10.5). Copper has a relatively low melting point of 1965° F. (1085° C.) and both a malleability (ability to be shaped) and ductility (ability to be drawn into wire) approaching that of silver. Native copper is never pure, but always contains some arsenic, antimony, bismuth, lead, iron, gold, or silver. Copper, gold, and silver are closely related metals that fall into column 11 of the periodic table of elements. Of these metals, copper is the most reactive and gold the least—the reason why gold usually occurs in native form, while native copper is rare.

A freshly exposed or cleaned native-copper surface has a diagnostic, bright, copper-red color. But because of copper’s reactivity, this surface quickly develops a green-to-black tarnish when the metal reacts with atmospheric oxygen, sulfurous gases, or carbonic acid. Oxidation from atmospheric oxygen produces a dark cuprite film, while reaction with hydrogen sulfide (H<sub>2</sub>S) creates a dark patina of chalcocite [copper sulfide, Cu<sub>2</sub>S]. Carbonic acid produced from the reaction of atmospheric carbon dioxide and water creates a coating of green malachite [basic copper carbonate, Cu<sub>2</sub>(CO<sub>3</sub>)(OH)<sub>2</sub>]. The greenish-black surface coloration present on all weathered copper surfaces is usually a combination of these oxidation products.

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Copper crystallizes in the isometric (cubic) system. Within the copper lattice, copper atoms occupy each of the eight corners of a cube and the centers of its six faces. In this configuration, each copper atom is surrounded by 12 identical atoms. Close atomic packing and a relatively high atomic weight explain copper's relatively high density. The copper lattice is held together entirely by metallic bonding, in which a field of moving, free electrons is attracted to the positively charged nuclei of the copper atoms. When shearing forces are applied to copper, metallic bonding enables lattice sections to slip along their atomic planes to deform rather than fracture, this accounting for copper's great malleability and ductility. Slippage of atomic planes under mechanical stress explains copper's softness.

Because copper has a great affinity for the common element sulfur, most of the copper in existence occurs as sulfide minerals. Native copper forms only in sulfur-deficient mineralogical environments. Most native copper occurs as fracture and fissure fillings and is deposited when circulating, copper-bearing groundwater solutions react with iron. The more chemically reactive iron displaces copper from solution causing it to precipitate in elemental form.

Copper has had a huge impact on world history and technological development. It is uncertain whether gold or copper was the first metal ever used, but copper was clearly the utilitarian metal that lifted mankind out of the Stone Age. By 10,000 B.C., early metalworkers were hammering bits of native copper into simple tools and implements. The Copper Age, the period when a particular culture's tools and weapons were made primarily of copper, occurred at different times in different regions. By 5000 B.C., certain Asian cultures were melting native copper in drafted charcoal furnaces and making simple castings. Their metalworkers were also attempting to melt certain minerals, such as malachite, that were associated with native copper. This produced elemental copper, the knowledge that malachite was a copper compound, and the development of smelting techniques to extract metals from metal-bearing minerals.

Native copper remained the primary source of copper for several millennia. The Bronze Age began after early metalworkers mixed native copper with tin to make bronze, an alloy with greater hardness and durability than copper, and one easily fabricated into improved utensils, tools, and weapons. By 1500 B.C., the Mediterranean island of Cyprus was supplying most of the world's copper. Knowledge gained by mining and working native copper was later applied to iron. But even during the subsequent Iron Age, copper remained indispensable. Although iron was hard and durable, it corroded much faster than copper, especially in saltwater environments. In the 1700s, brass, a copper-zinc alloy, came into common use. Native copper remained the primary ore of copper until about 1900, when advanced mining and milling technologies made possible the large-scale use of abundant copper-sulfide ores.

Copper has a long medicinal history. The Smith Papyrus, an Egyptian medical text dating to 2200 B.C., cites the effectiveness of pulverized copper in sterilizing wounds and treating drinking water. The Eber Papyrus of 1550 B.C. prescribed copper to treat headaches, burns, and itching. Ancient Greek and Roman physicians later used copper and its compounds to treat an even wider variety of ailments. The Greek physician Hippocrates (ca 460-ca 377 B.C.) treated ulcers and infections with copper, while Roman scholar Pliny the Elder (Gaius Plinius Secundus, 23-79 A.D.) described using copper to treat intestinal worms, mouth sores, and ear infections.



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Copper is an essential nutrient for all higher forms of plant and animal life. Most medical researchers now recognize the anti-inflammatory properties of copper and its benefits to the immune system. The beneficial effects of moderate consumption of red wine are attributed partially to high levels of copper in the skins of red-wine grapes. Today, many sufferers of arthritis and rheumatism wear copper bracelets to alleviate joint pain and swelling.

Modern metaphysical practitioners believe that copper's high electrical and thermal conductivity help to heal the mind and body, project the energy of mineral crystals, increase self-esteem, and stimulate psychic energies. Copper is also thought to assist in communicating and channeling, and ion cleansing and purifying the blood.

More than 18 million metric tons of copper are now mined worldwide each year. The United States mines 1.4 million metric tons annually to rank fourth in world production after Chile, China, and Peru. As the third most widely used metal after iron and aluminum, copper has many uses based on its high electrical and thermal conductivity, great malleability and ductility, resistance to corrosion, and alloying capabilities. Today, most copper goes into the manufacture electrical wire and cable, switches, contacts, power-generation equipment, motor brushes and armatures, and an array of electronic devices. A great deal of copper is also used in brass (copper-zinc) alloys, bronze (copper-tin) alloys, sterling (silver-copper) alloys, and exotic alloys with such metals as aluminum, beryllium, and titanium. Copper is a traditional coinage metal and is a component of virtually all modern coins, except those made of gold and platinum.

### *TECHNOLOGICAL USES*

Both cuprite and native copper were formerly important ores of copper.

### *ABOUT OUR SPECIMENS*

Our cuprite specimens were collected at the Carissa Pit in the Copper Basin area of the Battle Mountain Mining District. This district is near the community of Battle Mountain in Lander County, in the arid, basin-and-range country of north-central Nevada. Although unincorporated, Battle Mountain, population 3,600, is Lander County's largest community and its county seat. Covering 5,519 square miles, Lander County is larger than the state of Connecticut, yet it has only 6,000 residents. Battle Mountain's economy is based on gold and base-metal mining, ranching, and providing services for travelers on Interstate 80.

Copper mining began in the Battle Mountain Mining District in 1866, when a number of small mines were developed. The district's largest mine, the Copper Canyon Mine, produced copper and gold from 1917 to 1955, then reopened as an open pit in 1967. The discovery of additional copper ore zones, along with those of gold, silver, lead, and zinc, instilled new life into the district in the 1980s. Today, the major district mines are the Tomboy, Midas, Fortitude, and Phoenix open-pit mines, and the Copper Canyon underground mine.

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Geologists have traced the origin of the Battle Mountain Mining District ore deposits to the late Paleozoic Era, when sediments laid down between 300 million years and 240 million years ago lithified into massive formations of sandstone, siltstone, limestone, and shale. Some 40 million years ago, these formations were intruded by graniorite magma and associated mineral-rich, hydrothermal solutions that emplaced gold and disseminated sulfide minerals. After erosion had reduced the surface, these sulfide deposits were subjected to chemical weathering, oxidation, and the action of acidic groundwater. These collective effects of these processes, known as “supergene enrichment,” created the shallow and relatively rich deposits of copper, gold, silver, lead, and zinc that are mined in the district today. The Battle Mountain district is known for native copper, which formed as fracture and fissure fillings when copper-bearing groundwater solutions reacted with iron. The more chemically active iron displaced the copper from solution, reducing it and causing it to precipitate in elemental form.

The site of the today’s Carissa Pit had been mined sporadically for small amounts of rich, oxidized copper ore since the early 1900s. In 1936, the discovery of a small, but very rich, body of gold ore in an open cut led to the opening of the Carissa underground mine, which was eventually expanded to include several shaft-served levels and a surface glory hole. By the time this mine closed in 1954, it had produced 9,104 tons of ore that yielded 4,543 troy ounces of gold, 19,574 troy ounces of silver, and 270 tons of copper. The deposit was redeveloped as the Carissa Pit in the 1970s and mined sporadically from a surface excavation over the following decades. Previously mined by the Duval Corporation and the Battle Mountain Gold Corporation, this property is currently owned by the Newmont Mining Corporation. Exploration activities continue at the Carissa Pit, where commercial specimen collectors gathered our specimens of cuprite on copper in 2012.

Ore minerals at the Carissa Pit include native copper, cuprite, chalcocite [copper sulfide,  $\text{Cu}_2\text{S}$ ], chalcopyrite [copper iron sulfide,  $\text{CuFeS}_2$ ], pyrite [iron disulfide,  $\text{FeS}_2$ ], and pyrrhotite [iron sulfide,  $\text{FeS}$ ]. Significant amounts of gold are present in the pyrite, chalcopyrite, and pyrrhotite. The gangue minerals are diopside [calcium magnesium silicate,  $\text{CaMgSi}_2\text{O}_6$ ], epidote [basic calcium aluminum iron oxysilicate,  $\text{Ca}_2\text{Al}_2\text{Fe}(\text{Si}_2\text{O}_7)(\text{SiO}_4)\text{O}(\text{OH})$ ], and quartz [silicon dioxide,  $\text{SiO}_2$ ].

Your specimen of cuprite on copper from Nevada’s Carissa Pit is a composite in which cuprite covers a dendritic base of native copper. In many specimens, the edges of the underlying copper exhibit a distinct crystal pattern, and small sections of bright, metallic copper are visible beneath the cuprite covering. The cuprite occurs as a coating of brownish, opaque scales that are actually flattened and distorted octahedral crystals. Also present in many specimens are bits of translucent, gray quartz, along with a light-green crust that consists primarily of chalcantite [hydrous copper sulfate,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ].

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